

## **Employing a Multimodal Logic in an Approach to German Pronoun Fronting**

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### **0. Introduction**

As frameworks for accounting for natural language phenomena, the traditional categorial type logics have proved inadequate, due in one sense to the global availability of their structural rules. Because of this, relaxing structural sensitivity in order to account for specific phenomena involving non-adjacent composition entails relaxation of the entire system, which leads to overgeneration. To allow restricted access to non-adjacent modes of composition, Moortgat and Oehrle (1994) develop a multimodal logic of categorial type inference. In this paper, I propose an analysis of German pronoun fronting, and discuss how this and other German word order phenomena may be accounted for in Moortgat and Oehrle's theoretical framework.

### **1. Moortgat and Oehrle's Multimodal Logic**

#### **1.1 Categorial Type Logics**

The multimodal logic presented in Moortgat and Oehrle is based on type logics such as the Lambek Calculus (Lambek 1958, 1988). In these, the categorial reduction system assumed in classical categorial grammar is reinterpreted as a calculus analogous to the implicational fragment of propositional logic. As such, it consists of three components: a set of types, a model theoretic interpretation for those types, and a set of inference rules. The set of types is freely generated from a product connective ' $\circ$ ' and its left and right residuals ' $/$ ' and ' $\backslash$ ', together with a set of primitive categories (such as  $s$ ,  $np$ ,  $pp$ ). An intransitive verb, for example, will have the type ' $np\backslash s$ '; a category which needs an NP on its left to form a sentence.

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The function  $v$  is the model theoretic interpretation, mapping logical types into linguistic expressions:

$$(1) \quad \begin{aligned} v(A \circ B) &= \{xy \mid \exists x \in v(A) \ \& \ \exists y \in v(B)\} \\ v(C/B) &= \{x \mid \forall y(y \in v(B) \rightarrow xy \in v(C))\} \\ v(A \wedge C) &= \{y \mid \forall x(x \in v(A) \rightarrow xy \in v(C))\} \end{aligned}$$

Thus, for example, a category  $C/B$  is mapped onto a set of expressions  $x$  such that given an expression  $y$  of type  $B$  on its right, the resulting expression  $xy$  is of type  $C$ .

Given this interpretation of the set of types, the following residuation relation must hold among the type constructors:

$$(2) \quad A \rightarrow C/B \text{ iff } A \circ B \rightarrow C \text{ iff } B \rightarrow A \wedge C$$

The inference rules for the type constructors are presented here in Gentzen sequent notation.<sup>1</sup>  $A$ ,  $B$ , and  $C$ , are single occurrences of a type, while  $\Gamma$  and  $\Delta$  are terms representing a configuration of types. The notation  $\Delta[A]$  stands for a configuration of types  $\Delta$  containing an occurrence of  $A$ . The sequents themselves are of the form  $\Gamma \Rightarrow X$ , where  $\Gamma$  is a nonempty configuration of succedent types, and  $X$  is a single occurrence of a succedent type.

$$(3) \quad \begin{array}{c} [Ax] \frac{}{A \Rightarrow A} \\ \\ \frac{\Gamma, B \Rightarrow A}{\Gamma \Rightarrow A/B} [R/] \qquad \frac{\Gamma \Rightarrow B \quad \Delta[A] \Rightarrow C}{\Delta[A/B, \Gamma] \Rightarrow C} [L/] \\ \\ \frac{B, \Gamma \Rightarrow A}{\Gamma \Rightarrow B \vee A} [R\vee] \qquad \frac{\Gamma \Rightarrow B \quad \Delta[A] \Rightarrow C}{\Delta[B \vee A, \Gamma] \Rightarrow C} [L\vee] \\ \\ \frac{\Gamma[A, B] \Rightarrow C}{\Gamma[A \circ B] \Rightarrow C} [L\circ] \qquad \frac{\Gamma \Rightarrow A \quad \Delta \Rightarrow B}{\Gamma, \Delta \Rightarrow A \circ B} [R\circ] \end{array}$$

Each type constructor has a rule of introduction (a 'right' rule), and a rule of elimination (a 'left' rule). For example, the rule  $[L/]$  allows us to eliminate an occurrence of the  $/$  connective in  $A/B$  if there is a configuration of types  $\Gamma$  immediately to its right such that  $\Gamma$  can be proven to be an occurrence of  $B$ . The corresponding rule  $[R/]$  introduces an instance of the  $/$  onto the succedent type. A sequent can be proven to be valid in the type

<sup>1</sup> See Moortgat (1988:27-39) for a more detailed discussion of Gentzen-sequent derivations.

logic by using the rules of introduction and elimination to reduce all of the branches of the proof tree to occurrences of the Axiom case, also given in (3).

Thus a derivation of the sentence *John loves Mary*, (or rather, the configuration of types which has this sentence as its interpretation), will involve two applications of the [L] rule to prove that the type *s* is in fact derivable from the types assigned to the expressions *John*, *loves*, and *Mary*:

(4)

$$\begin{array}{c}
 \text{--- [Ax]} \quad \text{--- [Ax]} \\
 \text{--- [Ax]} \quad s \Rightarrow s \quad np \Rightarrow np \text{ [L]} \\
 np \Rightarrow np \quad (np, np/s) \Rightarrow s \text{ [L]} \\
 (np, ((np/s)/np, np)) \Rightarrow s
 \end{array}$$

In addition to the logical rules, the type logic may also include a set of structural rules, which do not prove any new formulas that are distinct with respect to the basic type logic, but rather allow us to characterize the linguistic forms corresponding to these formulas in a flexible and detailed way. The associative, non-commutative Lambek calculus  $L$ , for example, will have the following structural rule for Associativity as one of its properties:

$$(5) \quad \frac{\Gamma[(\Delta_1, (\Delta_2, \Delta_3))] \Rightarrow A}{\Gamma[(\Delta_1, \Delta_2), \Delta_3] \Rightarrow A} [\text{Assc}]$$

Because associativity renders the bracketing of a configuration of types irrelevant, parentheses are traditionally omitted in Gentzen proofs such as (4) when they are done in L. Alternatively, the structural rule in (5) could be explicitly appealed to in order to rebracket the configuration in the antecedent where necessary for the logical rules to be able to apply.

In the stronger Lambek-Van Benthem system known as **LP**, there is an additional structural rule for Permutation:

$$(6) \quad \frac{\Gamma[\Delta_2, \Delta_1] \Rightarrow A}{\Gamma[\Delta_1, \Delta_2] \Rightarrow A} [P]$$

This rule ensures that if A is derivable from a particular sequence of types, it is also derivable from any permutation of that sequence. Note that the derivation in (4) is possible in both **L** and **LP**, since no appeal to structural rules is necessary. However, unlike **L**, it is possible in **LP** to derive the topicalized sentence *Mary*, *John loves*, because Permutation is available to reorder the succedent types so that the logical rules can apply:<sup>2</sup>

<sup>2</sup>Since LP is associative, the parentheses in this derivation are omitted.

(7)

$$\begin{array}{c}
 \frac{}{[Ax]} \quad \frac{}{[Ax]} \\
 \frac{}{[Ax]} \quad s \Rightarrow s \quad \frac{}{np \Rightarrow np} [L] \\
 \frac{}{np \Rightarrow np} \quad \frac{}{np, np/s \Rightarrow s} [L] \\
 \frac{}{np, (np/s)/np, np \Rightarrow s} [P] \\
 np, np, (np/s)/np \Rightarrow s
 \end{array}$$

Since structural rules like Permutation are global options, always available, **LP** is of course much too strong, and can derive many ungrammatical sentences as well. Clearly what is needed is some way to have limited access to these structural rules, so that they can be used only when needed for particular constructions. To this end, Moortgat and Oehrle (1994) propose a multimodal type logic, in which it is possible to combine various modes of composition into the same system.

## 1.2 Multimodal type logic

The multimodal type logic proposed by Moortgat and Oehrle takes as its basis the architecture of classical categorial type logics, but no longer includes just one set of type constructors whose properties are interpreted with respect to one set of structural rules. Instead, all type constructors are subscripted with an index  $i \in I$ , where  $I$  is the set of *resource management modes*, which may have properties like associativity and commutativity.<sup>3</sup> Thus for every mode  $i$  there exists a family of type constructors  $\{ \circ_i, /_i, \backslash_i \}$ .

The type constructors are now interpreted with respect to multimodal (Kripke style) ternary frames  $\langle W, R_i \rangle$ , where the 'worlds'  $W$  are the linguistic expressions, and  $R$  is a three-place accessibility relation over  $W$ . The function  $v$  now respects the structure of the complex types, (where ' $R_ixyz$ ' is read as 'combining expressions  $x$  and  $y$  in mode  $i$  yields the expression  $z$ ').

(8)

$$\begin{aligned}
 v(A \circ_i B) &= \{ z \mid \exists x \exists y [R_ixyz \ \& \ x \in v(A) \ \& \ y \in v(B)] \} \\
 v(C /_i B) &= \{ x \mid \forall y \forall z [(R_ixyz \ \& \ y \in v(B)) \rightarrow z \in v(C)] \} \\
 v(A \backslash_i C) &= \{ y \mid \forall x \forall z [(R_ixyz \ \& \ x \in v(A)) \rightarrow z \in v(C)] \}
 \end{aligned}$$

For example,  $C /_i B$  is mapped onto an expression  $x$  such that if  $x$  is combined with  $y$  in mode  $i$  to yield  $z$ , and  $y$  is an expression of type  $B$ , then  $z$  is an expression of type  $C$ .

Consequently, the residuation laws will also respect the resource management modes:

<sup>3</sup>The properties of the individual modes are expressed via Kripke style frame conditions. For example, if  $c$  is a commutative mode, then it must satisfy the condition:

$$(i) \quad (\forall x, y, z \in W) R_cxyz \Rightarrow R_cyxz$$

See Moortgat & Oehrle (1994:3) for further details.

(9)

$$A \rightarrow C/iB \text{ iff } A \circ_i B \rightarrow C \text{ iff } B \rightarrow A \vee_i C$$

The inference rules will be similarly parameterized, as shown in (10). Because concatenation is no longer the only way of combining two expressions, the notation  $(A, B)^i$ , which is understood as the result of combining  $A$  and  $B$  in mode  $i$ , is now necessary in order to specify the mode of combination.

(10)

$$\begin{array}{ll} \frac{(\Gamma, B)^i \Rightarrow A}{[R/i]} \Gamma \Rightarrow A/iB & \frac{\Gamma \Rightarrow B \quad \Delta[A] \Rightarrow C}{[L/i]} \Delta[(A/iB, \Gamma)_i] \Rightarrow C \\ \\ \frac{(\Gamma, B)^i \Rightarrow A}{[R\vee]} \Gamma \Rightarrow B \vee_i A & \frac{\Gamma \Rightarrow B \quad \Delta[A] \Rightarrow C}{[L\vee]} \Delta[(\Gamma, B \vee A)_i] \Rightarrow C \\ \\ \frac{\Gamma[(A, B)^i] \Rightarrow C}{[L\circ_i]} \Gamma[A \circ_i B] \Rightarrow C & \frac{\Gamma \Rightarrow A \quad \Delta \Rightarrow B}{[R\circ_i]} (\Gamma, \Delta)_i \Rightarrow A \circ_i B \end{array}$$

For example, the  $[L/i]$  rule can be used to prove that a type  $A/iB$  combined with  $B$  in mode  $i$  derives  $A$ , whereas it can not prove that  $A/iB$  combined with  $B$  in mode  $j$  derives  $A$ .

Crucially, the structural rules are no longer a global option, but are now mode-specific. For example, Permutation is restricted to those types composed in a commutative mode, represented by  $c$ , and rebracketing is restricted to associative modes,  $(a)$ :

(11)

$$\frac{\Gamma[(\Delta_2, \Delta_1)^c] \Rightarrow A}{[P]} \Gamma[(\Delta_1, \Delta_2)^c] \Rightarrow A$$

(12)

$$\frac{\Gamma[(\Delta_1, (\Delta_2, \Delta_3)^a)^a] \Rightarrow A}{[Assoc]} \Gamma[((\Delta_1, \Delta_2)^a, \Delta_3)^a] \Rightarrow A$$

In addition to the Gentzen-sequent presentation, it is also possible to express the multimodal type logic using an axiomatic presentation.<sup>4</sup> Since in some ways, this presentation is clearer than the Gentzen-sequent, I introduce it here in order to eventually use it to illustrate partial derivations. Corresponding to the structural rules in (11) and (12) there are structural axioms for commutativity and associativity:

<sup>4</sup>See Moortgat and Oehrle (1994:3-4) for discussion.

(13)

$$A \circ_c B \leftrightarrow B \circ_c A$$

(14)

$$(A \circ_a B) \circ_a C \leftrightarrow A \circ_a (B \circ_a C)$$

Since each derivation may involve multiple modes of combination, it is also necessary to have rules or axioms to relate different modes to one another. These will take the form of Inclusion and Interaction Rules/Axioms. The Inclusion Rules/Axioms relate two modes in terms of how informative they are with respect to the structure of the linguistic expressions.

One such Inclusion Rule will be for non-commutative ( $n$ ) and commutative ( $c$ ) products. Since  $n$  is more informative than  $c$  (it places an additional restriction on the structure of the expressions), it will hold that whenever two expressions are combined in a non-commutative mode, they may also be combined in a commutative mode to yield the same result.<sup>5</sup> Therefore in order for the logic to be complete, the Inclusion Rule in (15) and corresponding Inclusion Axiom in (16) are necessary:

(15)

$$\Gamma[(\Delta_1, \Delta_2)^c] \Rightarrow A$$

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$$\Gamma[(\Delta_1, \Delta_2)^n] \Rightarrow A$$

(16)

$$A \circ_n B \rightarrow A \circ_c B$$

The Interaction Rules/Axioms regulate communication between two modes found in a single configuration. As an example, consider Moortgat & Oehrle's Interaction Rule/Axiom of Mixed Associativity, where  $i$  represents some adjacent mode of communication, and  $j$  some non-adjacent mode.<sup>6</sup>

(17)

$$\Gamma[(\Delta_1, (\Delta_2, \Delta_3)^j)^i] \Rightarrow A$$

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$$\Gamma[(\Delta_1, \Delta_2)^i, \Delta_3]^j \Rightarrow A$$

(18)

$$\text{Ax2: } (A \circ_i B) \circ_j C \rightarrow A \circ_i (B \circ_j C)$$

<sup>5</sup>Formally, this property is expressed by the following frame condition (Moortgat & Oehrle 1994:3):

$$(i) \quad (\forall x, y, z \in W) R_{xyz} \Rightarrow R_{cxyz}$$

<sup>6</sup>Ax2 and R2 correspond to the following frame condition:

$$(i) \quad (\forall xyzuv \in W)[(R_{xyz} \& R_{zuv}) \Rightarrow \exists t(R_{xut} \& R_{tyv})]$$

See Moortgat & Oehrle 1994:7-9 for a more detailed explanation of the "adjacency parameter."

These can then be used to constrain specific cases by replacing *i* and *j* with the appropriate type constructors, these axioms serve to constrain specific cases. More concrete examples of Interaction Axioms will be given later.

### 1.3 Prosodic sort labelling

To further increase the expressive power of the type logic, Moortgat and Oehrle introduce a sort labelled type system, where every (sub)type has a subscript indicating its prosodic sort.<sup>7</sup> Thus there may be a distinction for example between an expression *A* of a 'lexical' sort, written  $A_w$ , and an expression *A* of a 'phrasal' sort, written  $A_{ph}$ .

The sorts are structured on an inheritance hierarchy, so that a more general sort subsumes a more specific sort; hence the phrasal sort subsumes the lexical sort. This means that it is possible to infer that any type of sort word is also of sort phrase, using the axiom in (20) which is based on the logical axiom schema in (19):

$$(19) \quad A_a \rightarrow A_b \text{ if } b \sqsubseteq a$$

$$(20) \quad A_w \rightarrow A_{ph} \quad ph \sqsubseteq w$$

The sorts are also useful for distinguishing composition at different levels, such as affixation at the word level from concatenation in the syntax.<sup>8</sup>

### 1.4 Moortgat & Oehrle's analysis of Dutch verb-raising and cross-serial dependencies

As an illustration of how their system may be applied to linguistic phenomena, Moortgat and Oehrle present an analysis of Dutch verb-raising and cross-serial dependency. While they restrict themselves to an example using intransitive verbs, I provide a derivation with transitive verbs to make it apparent how the analysis predicts the cross-serial dependency.<sup>9</sup> Furthermore, since their treatment of verb raising involves "clustering" of the verbs, this may later be compared to my analysis of German pronoun fronting which involves pronoun clusters.

In Dutch, verbs may cluster at the end of an embedded clause, resulting in a cross-serial dependency between the verbs and their arguments.

- (21)
- |       |     |       |       |          |      |          |       |         |
|-------|-----|-------|-------|----------|------|----------|-------|---------|
| dat   | Jan | Marie | de    | kinderen | bier | zag      | laten | drinken |
| that  | Jan | Marie | the   | children | beer | see      | let   | drink   |
| 'that | Jan | sees  | Marie | let      | the  | children | drink | beer'   |

To apply the multimodal type logic in an analysis of this phenomenon, Moortgat and Oehrle introduce headedness as another parameter for the resource management

<sup>7</sup>See Moortgat & Oehrle (1994:6) for details on further adjustments now required in the model theory and proof theory.

<sup>8</sup>See Moortgat & Oehrle (1994:7) for an example showing how the use of a labelled type system allows both phrasal and lexical composition within a single derivation.

<sup>9</sup>The derivation of (21) was worked out in David Dowty's Winter 1995 Categorical Grammar seminar.

modes. The products  $\circ_l$  and  $\circ_r$  combine two types such that the left or right subtype, respectively, is the head. They also introduce various wrapping modes, which allow for non-adjacent composition.<sup>10</sup> In particular,  $\circ_{lh}$  is a mode which combines two types such that the left subtype is the head, which wraps, or 'infixes', into the right subtype.

They also introduce new prosodic sorts. In their analysis, the verbs *zag* and *laten* would be sort *i* for 'infixing verb', because they are wrapped into their VP argument, which they subcategorize for in the *lh* mode of combination. The verb *drinken* would be of sort *v* for 'verb' or 'verb cluster.' The infixing verbs form a recursively built verb cluster with the verb of sort *v*, so that the verb cluster in (21) will look like:

$$(22) \quad (\text{zag}_i \circ_l (\text{laten}_i \circ_l \text{drinken}_v)_v)_v$$

On the sort hierarchy, *v* is supralexicale but subphrasal, ( $\text{ph} \subseteq v \subseteq w$ ). The result is that it may contain multiple lexical verbs without also allowing composition at the phrasal level to take place. This is necessary since full phrasal complements are excluded from the verb clusters.

Thus the expressions will have the following category assignments (where *vp* abbreviates  $\text{np} \setminus v$ , and the prosodic sort is phrasal where it is not indicated):

$$(23) \quad \begin{array}{ll} \text{Jan, bier, etc.} & \text{np} \\ \text{drinken} & (\text{np} \setminus \text{vp})_v \\ \text{zag} & ((\text{np} \setminus \text{vp}) /_{lh} \text{vp})_i \\ \text{laten} & ((\text{np} \setminus \text{vp}) /_{lh} \text{vp})_i \end{array}$$

Finally, it will be necessary to have Inclusion and Interaction Rules/Axioms.<sup>11</sup> Here I will only give the axiomatic presentation. First note that the following Inclusion Axiom is valid because it involves going from a more informative mode (simple left-headed concatenation) to a less informative mode (one which allows permutation):

$$(24) \quad (A \circ_l B) \rightarrow (A \circ_{lh} B)$$

The job of the Inclusion Axiom here will be to allow a verb cluster, in which the types are combined in the *l* mode, to be reanalyzed as phrase-level configuration in which the types are combined in the *lh* mode. Therefore it is necessary to constrain the Inclusion Axiom in (24) to a more specific sort-decorated configuration. The left side of the axiom is recognizable as the form of a verb cluster, with the right side reflecting the appropriate changes in sort and mode of composition:

$$(25) \quad \text{A1: } (A_i \circ_l B_v)_v \rightarrow (A_i \circ_{lh} B_v)_{ph}$$

This change will allow the configuration to be available so that the relevant Interaction Axiom, A5, may apply. The effect of A5 is simply to allow the wrapped in 'infixing' verb to permute up a right-headed string, while preserving any sort information that is present on the subtypes:

<sup>10</sup>See Moortgat & Oehrle (1994:9-11) for discussion of their complete set of head wrapping products.

<sup>11</sup>See Moortgat & Oehrle (1994:10) for more details on the communication between the dependency system (i.e. concatenative modes), and the head wrapping system.



(26)

$$A5: A \circ_r (B \circ_{lh} C) \rightarrow B \circ_{lh} (A \circ_r C)$$

Now a (partial) derivation of (21) can be given in the axiomatic presentation (where again the sort of the types is **ph** if not otherwise specified):

(21')

dat  $\circ_l$  (Jan  $\circ_r$  (Marie  $\circ_r$  (de kinderen  $\circ_r$  (bier  $\circ_r$  (zag<sub>i</sub>  $\circ_l$  (laten<sub>i</sub>  $\circ_l$  trinken<sub>v</sub>)<sub>v</sub>))))))  
 $\downarrow$  A1 (*twice*)  
 dat  $\circ_l$  (Jan  $\circ_r$  (Marie  $\circ_r$  (de kinderen  $\circ_r$  (bier  $\circ_r$  (zag<sub>i</sub>  $\circ_{lh}$  (laten<sub>i</sub>  $\circ_{lh}$  trinken<sub>v</sub>))))))  
 $\downarrow$  A5  
 dat  $\circ_l$  (Jan  $\circ_r$  (Marie  $\circ_r$  (de kinderen  $\circ_r$  (zag<sub>i</sub>  $\circ_{lh}$  (bier  $\circ_r$  (laten<sub>i</sub>  $\circ_{lh}$  trinken<sub>v</sub>))))))  
 $\downarrow$  A5  
 dat  $\circ_l$  (Jan  $\circ_r$  (Marie  $\circ_r$  (zag<sub>i</sub>  $\circ_{lh}$  (de kinderen  $\circ_r$  (bier  $\circ_r$  (laten<sub>i</sub>  $\circ_{lh}$  trinken<sub>v</sub>))))))  
 $\downarrow$  A5  
 dat  $\circ_l$  (Jan  $\circ_r$  (Marie  $\circ_r$  (zag<sub>i</sub>  $\circ_{lh}$  (de kinderen  $\circ_r$  (laten<sub>i</sub>  $\circ_{lh}$  (bier  $\circ_r$  trinken<sub>v</sub>))))))  
 s/s np np ((np<sub>v</sub>-vp)/<sub>lh</sub>vp)<sub>i</sub> np ((np<sub>v</sub>-vp)/<sub>lh</sub>vp)<sub>i</sub> np (np<sub>v</sub>-vp)<sub>v</sub>

Throughout this paper, for the sake of clarity, the derivations will include the lexical expressions rather than their types up until the last line; the axioms should still be understood as operating on types. The first line is the hypothesized string which is to be proven to be a sentence.

The Inclusion Axiom A1 applies to it twice to 'undo' each part of the recursively built verb cluster. At this point the Interaction Axiom A5 may apply to move first the infixing verb *zag*, and then *laten*, up the right-headed string. In the last line, it can be verified that the types are in the proper configuration for the logical connectives to be eliminated; this last part of the derivation is not given.

## 2. German Data

### 2.1 General Assumptions

The data discussed here will be restricted to embedded clauses which exhibit the SOV order considered basic for German. The assumption here, common in studies of German syntax, is that the best strategy for analyzing certain phenomena is to begin with verb-final clauses because they represent the most general case. Later the analysis may be extended to verb-second and verb-initial clauses.<sup>12</sup>

Furthermore, only data with constituents in their "unmarked" order will be discussed. Here the term "unmarked" is used as defined by Lenerz (1977), that is, roughly, the word order which is considered to be grammatical given any context.

<sup>12</sup>What this means for the present analysis is that pronouns will be treated as clustering with an initial complementizer in an embedded clause with SOV word order. However, if the analysis were extended to verb-second or verb-initial clauses, the pronouns would then be considered to cluster with the preceding finite verb. Further discussion appears in §2.5.

## 2.2 Pronoun Fronting

It has often been noted that in German, unstressed pronouns appear together at the left in an embedded clause, and that unlike full NPs, they always remain in a fixed order with respect to one another, namely *nom>acc>dat* (e.g. Lenerz 1977, Uszkoreit 1987). Lenerz also observes that if the subject is a full NP, it has the option of appearing to the left of the pronouns, and that this order is equally unmarked. Thus given an embedded clause with a transitive verb, the following judgments hold:

- (27) daß der Doktor        den Mann        sieht  
       *that the doctor-NOM the man-ACC sees*
- (28) daß er                den Mann        sieht  
       *that he-NOM the man-ACC sees*
- (29) \*daß den Mann        er                sieht  
       *that the man-ACC he-NOM sees*
- (30) daß der Doktor        ihn                sieht  
       *that the doctor-NOM him-ACC sees*
- (31) daß ihn                der Doktor        sieht  
       *that him-ACC the doctor-NOM sees*
- (32) daß er                ihn                sieht  
       *that he-NOM him-ACC sees*
- (33) \*daß ihn                er                sieht  
       *that him-ACC he-NOM sees*

## 2.3 Unmarked order of NPs

There is some debate as to the unmarked order for accusative and dative arguments when they are full NPs. One view is that either order is unmarked, whereas the other is that only the *dat>acc* order is possible without special context. Lenerz discusses the two possibilities, and comes down in favor of the latter by applying his tests for markedness to sentences with the verb *geben*, 'to give'. The issue does not seem to be settled, (cf. Gadler 1982), but here it will be assumed that Lenerz is correct, and that the unmarked order for full NPs is *nom>dat>acc*.

This together with the facts about pronoun fronting discussed above means that given an embedded clause with a ditransitive verb, only the following orders are grammatical (and unmarked):

- (34) daß der Doktor        dem Mann        das Buch        gibt  
       *that the doctor-NOM the man-DAT the book-ACC gives*
- (35) daß er                dem Mann        das Buch        gibt  
       *that he-NOM the man-DAT the book-ACC gives*
- (36) a. daß der Doktor        ihm                das Buch        gibt  
       *that the doctor-NOM him-DAT the book-ACC gives*

- b. daß ihm der Doktor das Buch gibt  
*that him-DAT the doctor-NOM the book-ACC gives*
- (37) a. daß der Doktor es dem Mann gibt  
*that the doctor-NOM it-ACC the man-DAT gives*  
 b. daß es der Doktor dem Mann gibt  
*that it-ACC the doctor-NOM the man-DAT gives*
- (38) daß er ihm das Buch gibt  
*that he-NOM him-DAT the book-ACC gives*
- (39) daß er es dem Mann gibt  
*that he-NOM it-ACC the man-DAT gives*
- (40) a. daß der Doktor es ihm gibt  
*that the doctor-NOM it-ACC him-DAT gives*  
 b. daß es ihm der Doktor gibt  
*that it-ACC him-DAT the doctor-NOM gives*
- (41) daß er es ihm gibt  
*that he-NOM it-ACC him-DAT gives*

Personal pronouns, as noted, indisputably appear in the order *nom>acc>dat*. This discrepancy has generally been treated as an idiosyncratic fact, and apparently no plausible explanation has been put forth.<sup>13</sup> Therefore I will similarly not attempt an explanation, but rather will later account for the difference in §3.3 by having ditransitive verbs wrap an accusative full NP in over the dative argument.

## 2.4 Adverbials

The ordering of adverbials with respect to arguments of the verb is governed by many factors, including of course the type of adverbial itself (Uszkoreit 1987). Therefore the discussion here is limited to the sentential adverb *trotzdem*, 'nonetheless', which is able to appear in any position among full NP arguments:

- (42) a. daß trotzdem der Doktor dem Mann das Buch gibt  
*that nonetheless the doctor the man the book gives*  
 b. daß der Doktor trotzdem dem Mann das Buch gibt  
 c. daß der Doktor dem Mann trotzdem das Buch gibt  
 d. daß der Doktor dem Mann das Buch trotzdem gibt

However, the adverb may not appear among the pronouns and the element to their left (which will be either the complementizer or an NP subject):<sup>14</sup>

<sup>13</sup>Thiersch (1978) does in fact attempt a principled explanation by claiming that an accusative pronoun (but not an accusative NP) moves to a special 'W' (for 'Wackernagel') node between the nominative and dative argument positions, where it may cliticize onto the preceding element and become phonologically reduced. This account has a number of problems I will not discuss here; see also McKay (1985) for discussion.

<sup>14</sup>Grewendorf and Sternefeld (1990) also note that scrambling of full NPs cannot result in an NP appearing to the left of a pronominal subject. Presumably this could be extended to the generalization that scrambling cannot result in an NP appearing anywhere among pronouns and their host.

- (43) a. daß trotzdem der Doktor es ihm gibt  
           *that nonetheless the doctor it him gives*  
       b. \*daß der Doktor trotzdem es ihm gibt  
       c. \*daß der Doktor es trotzdem ihm gibt  
       d. daß der Doktor es ihm trotzdem gibt
- (44) a. \*daß trotzdem er dem Mann das Buch gibt  
           *that nonetheless he the man the book gives*  
       b. daß er trotzdem dem Mann das Buch gibt

## 2.5 Pronoun fronting as "clustering"

Given these data, German pronouns can be seen to share several properties generally attributed to clitics, (observed, e.g. in Zwicky 1977). To begin with, they are phonologically light, being monosyllabic and unstressed. Secondly, pronouns appear in a rigidly fixed position within the clause, always after the complementizer or NP subject in these cases. Their order with respect to one another is also fixed as nom>acc>dat, and is different from the canonical order of full NPs. Finally, no other elements may intervene between two pronouns, or between a pronoun and the element immediately to its left.

German pronouns are not traditionally considered to be clitics, as they generally do not exhibit phonological reduction.<sup>15</sup> However, the fact that they have these properties suggests that it is not unreasonable to analyze them as such.<sup>16</sup> (David Dowty, Arnold Zwicky, p.c.) In order to account for the fixed order of the pronouns and the unacceptability of intervening elements, I will be treating these configurations involving pronoun fronting as recursively built up "clitic" clusters, with the complementizer or NP subject acting as the original host.

While complementizers and NPs are unusual hosts for clitics, it should be kept in mind that the treatment here of pronouns in verb final clauses is only a preliminary step. The analysis given here should eventually extend to verb initial and verb second clauses as well. In such clause types, the pronouns are for the most part found clustering around the finite verb. The approach being developed here will therefore involve pronouns attaching to the finite verb, a much more familiar type of host. It is only because of the assumption that verb final clauses are more basic than verb initial and verb second clauses that complementizers, rather than finite verbs, are behaving as hosts. Presumably the two play parallel syntactic roles in their respective clauses.

<sup>15</sup>An exception is the accusative neuter pronoun *es*, which is treated by Thiersch (1978) as a clitic because it may in fact be phonologically reduced.

<sup>16</sup>Zwicky (1977:6) cites Hale's (1973:339-44) discussion of the Australian language Warramunga. Hale observes that Warramunga seems to be in an intermediate stage in the development of its pronouns from independent words to clitics, while the neighboring language Walpiri has already fully developed its pronouns as clitics. The description of Warramunga pronouns is strikingly similar to German pronouns: "...in Warramunga the clitic pronouns are merely unstressed variants of independent pronouns, but have moved into 'second position,' after the first (nonpronominal) constituent of the sentence."

### 3. An account of German pronoun fronting

#### 3.1 Pronoun clusters (with the complementizer as host)

To show how these generalizations about German word order can be analyzed in a multimodal framework, I will begin by discussing pronoun clusters with a complementizer host, as found in examples (31) and (32), repeated here:

(31) [daß ihn]        der Doktor        sieht  
       that him(acc) the doctor(nom) sees

(32) [[daß er]        ihn]        sieht  
       that he(nom) him(acc) sees

Complementizers will be of sort **h**, for 'host', as will the pronoun clusters which are built up recursively from the original host. The pronouns themselves will be of sort **p**, while full NPs are of sort **ph**. This enables verbs to have a type such that they combine with full NPs with right-headed concatenation, but with pronouns in a new *rp* ('right-headed pronominal') mode, henceforth abbreviated *p*. This will ultimately result in pronouns being linearized in pronoun clusters. Thus the type assignments will be:

(45)

<i>daß</i>	$(s'/s)_h$	
<i>er, ihn</i>	$np_p$	
<i>der Doktor</i>	$np_{ph}$	
<i>sehen</i>	$NP_{(p)}(NP_{(p)}s)$	where: $NP_{(p)}A = np_{ph} \setminus_r A \cup np_p \setminus_p A$

In the type for *sehen*, the symbol ' $\cup$ ' indicates a type which is the join of two other types.<sup>17</sup> This type will therefore be the join of the following four types, exhausting the possible combinations of pronominal and NP arguments:

(46)

$np_{ph} \setminus_r (np_{ph} \setminus_r s)$	$np_p \setminus_p (np_{ph} \setminus_r s)$
$np_{ph} \setminus_r (np_p \setminus_p s)$	$np_p \setminus_p (np_p \setminus_p s)$

On the sort hierarchy, **h** will be supralexical but subphrasal (i.e.  $ph \subseteq h \subseteq w$ ), like Moortgat and Oehrle's *v* sort, so that an element of sort **h** may contain multiple lexical items, without being a phrase prosodically. However, it is crucial that sort **p** not be subsumed by the sort **ph**. Otherwise, it would be a valid step in a derivation to make the inference that pronouns are also sort **ph**, which would allow them to be combined with the verb in the *r* mode rather than the *p* mode. This would then preclude their forming pronoun clusters.

Given these sorts and type assignments, the following Inclusion Axiom will be necessary:

(47)

$$A1: (A_h \circ_l B)_h \rightarrow (A_h \circ_p B)_{ph}$$

<sup>17</sup>See Moortgat & Oehrle (1994:20) for further discussion of join types.

A1 will apply to a configuration unique to pronoun clusters, reanalyzing it as a phrase-level type where the subtypes are combined in the *p* mode.

This will allow the new configuration to have access to the following Interaction Axioms:

$$(48) \quad A4: (A \circ_p B) \circ_l C \rightarrow A \circ_l (B \circ_p C)$$

$$(49) \quad A5: A \circ_p (B \circ_r C) \rightarrow B \circ_r (A \circ_p C)$$

Their effects are illustrated in the derivation for (31):<sup>18</sup>

$$\begin{aligned} (31') \quad & (da\beta_h \circ_l ihn)_h \circ_l (der \text{ Doktor } \circ_r sieht) \\ & \downarrow A1 \\ & (da\beta_h \circ_p ihn) \circ_l (der \text{ Doktor } \circ_r sieht) \\ & \downarrow A4 \\ & da\beta_h \circ_l (ihn \circ_p (der \text{ Doktor } \circ_r sieht)) \\ & \downarrow A5 \\ & \underline{da\beta_h \circ_l (der \text{ Doktor } \circ_r (ihn \circ_p sieht))} \\ & (s'/s)_h \quad np_{ph} \quad \quad np_p \quad np_p \backslash p(np_{ph} \backslash s) \end{aligned}$$

The first step in this derivation is to apply A1 to reanalyze the pronoun cluster; A4 then rebrackets the string so that the pronoun is now combined with the string on its right in the *p* mode. Now A5 permutes the pronoun down through the right-headed string. After one application, the pronoun has reached the site at which the conditions for the elimination of the logical connectives are met.

The derivation of (32) shows how pronoun clusters are built up recursively:

$$\begin{aligned} (32') \quad & ((da\beta_h \circ_l er)_h \circ_l ihn)_h \circ_l sieht \\ & \downarrow A1 \\ & ((da\beta_h \circ_l er)_h \circ_p ihn) \circ_l sieht \\ & \downarrow A1 \\ & ((da\beta_h \circ_p er) \circ_p ihn) \circ_l sieht \\ & \downarrow A4 \\ & (da\beta_h \circ_p er) \circ_l (ihn \circ_p sieht) \\ & \downarrow A4 \\ & \underline{da\beta_h \circ_l (er \circ_p (ihn \circ_p sieht))} \\ & (s'/s)_h \quad np_p \quad np_p \quad np_p \backslash p(np_p \backslash p s) \end{aligned}$$

Here A1 applies twice, first to 'undo' the outer cluster in which *ihn* takes *daß er* as its host, then the inner cluster in which *er* takes *daß* as its host. Since the types are already in the proper linear order, A4 applies twice to simply rebracket the string.

<sup>18</sup>Where the sorts are left unmarked in these derivations, the sort of the pronouns is understood as *p*, and elsewhere, *ph*.

Given these axioms, it is mandatory for the pronouns to start out as part of a cluster in the linearized string. The only possible mode of combination in a linearized string is concatenation, so that in order for the pronouns to be combined in the *p* mode required by the verb's type, A1 must be able to apply. But A1 is restricted to the configuration of a pronoun cluster, so it will be impossible to derive (32) by starting, for example, with the linearized string in (32''):

- (32'') \*daß<sub>h</sub> °<sub>l</sub> (er °<sub>r</sub> (ihn °<sub>r</sub> sieht))

Similarly, the ungrammatical example (29) may not be derived, where (29') is given below as a possible starting point for an attempt at a derivation:

- (29) \*daß den Mann er sieht  
(29') \*daß<sub>h</sub> °<sub>l</sub> (den Mann °<sub>r</sub> (er °<sub>r</sub> sieht))

Finally, this analysis also predicts that pronouns must remain in the same order with respect to each other. Therefore it will not be possible to derive (33):

- (33) \*daß ihn er sieht  
(33') ((daß<sub>h</sub> °<sub>l</sub> ihn)<sub>h</sub> °<sub>l</sub> er)<sub>h</sub> °<sub>l</sub> sieht  
↓ A1  
((daß<sub>h</sub> °<sub>l</sub> ihn)<sub>h</sub> °<sub>p</sub> er) °<sub>l</sub> sieht  
↓ A1  
((daß<sub>h</sub> °<sub>p</sub> ihn) °<sub>p</sub> er) °<sub>l</sub> sieht  
↓ A4  
(daß<sub>h</sub> °<sub>p</sub> ihn) °<sub>l</sub> (er °<sub>p</sub> sieht)  
↓ A4  
daß<sub>h</sub> °<sub>l</sub> (ihn °<sub>p</sub> (er °<sub>p</sub> sieht))  
↓ ?

While all the same steps may occur as they did in the derivation of (32), there now needs to be a way to permute the object *ihn* over the subject *er*. However, A5 is the only Interaction Axiom allowing permutation of a pronoun, and it requires that the mode of combination on the right be right-headed concatenation, while in this configuration that mode is *p*. Thus pronouns may never permute over one another, and will remain in their fixed order.

Note also that A5 will prevent a pronoun from starting in a higher clause and permuting down into the embedded clause, because such a move would require permutation over left-headed concatenation, the mode in which the complementizer combines with the sentence.

### 3.2 Pronoun clusters (with the NP subject as host)

As was noted in §2.1, a full NP subject is the only element that can appear between pronouns and the complementizer in an embedded clause:

## (30) daß der Doktor ihn sieht

In such cases, it appears that the NP subject is behaving as the host for a pronoun cluster. Thus it can be assumed that like complementizers, all nominative NPs are sort *h* as well,<sup>19</sup> and *der Doktor ihn* will be a pronoun cluster.

Note that subject NPs are subcategorized for by the verb with right-headed concatenation. Therefore the pronoun cluster in (30), (consisting of the subject NP and the object pronoun), will be combined with the string on its right with right-headed concatenation. A4 will not apply to this configuration, since is designed to rebracket a string in which the pronoun cluster has a complementizer host, and is thus combined with the string on its right with left-headed concatenation. Instead, a new axiom, A4' will allow this step:

(50)  $A4': (A \circ_p B) \circ_r C \rightarrow A \circ_r (B \circ_p C)$ 

The derivation for (30) shows how A1 still applies to introduce the *p* mode, so that A4' may rebracket the string:

(30') daß<sub>h</sub> ∘<sub>l</sub> ((der Doktor<sub>h</sub> ∘<sub>l</sub> ihn)<sub>h</sub> ∘<sub>r</sub> sieht)  
 ↓ A1  
 daß<sub>h</sub> ∘<sub>l</sub> ((der Doktor<sub>h</sub> ∘<sub>p</sub> ihn) ∘<sub>r</sub> sieht)  
 ↓ A4'  
 daß<sub>h</sub> ∘<sub>l</sub> (der Doktor<sub>h</sub> ∘<sub>r</sub> (ihn ∘<sub>p</sub> sieht))  
 ↓  
 daß<sub>h</sub> ∘<sub>l</sub> (der Doktor ∘<sub>r</sub> (ihn ∘<sub>p</sub> sieht))  
 (s/s)<sub>h</sub> np<sub>ph</sub>                      np<sub>p</sub>    np<sub>p</sub>\<sub>p</sub>(np<sub>ph</sub>\s)

There is still one final step necessary after A4'. The verb subcategorizes for a subject NP of sort *ph*, but *der Doktor* is sort *h*. Since *ph* subsumes *h* on the sort hierarchy, an axiom exists following the logical axiom schema given in (19):

(51)  $A_h \rightarrow A_{ph}$ 

This allows the inference in the last step of (4') to be made, after which the logical connectives may be eliminated.

### 3.3 Wrapping account of nom>dat>acc order of NPs

Examples (34) and (41), repeated here, show the differing unmarked orders for pronominal and NP arguments:

(34) daß der Doktor            dem Mann    das Buch            gibt  
       *that the doctor-NOM the man-DAT the book-ACC gives*

(41) daß er            es            ihm            gibt  
       *that he-NOM it-ACC him-DAT gives*

<sup>19</sup>This point will be elaborated upon further in §4.2.



By giving a ditransitive verb a type that subcategorizes for the accusative argument in a right-headed 'wrap' mode,  $rw$ , only when it is a full NP, it is possible to correctly predict this difference. (The new wrap mode,  $rw$ , will henceforth be abbreviated  $w$ .) Since the Inclusion Axiom which introduces the wrap mode may only apply to a configuration with a verb, verbs will be made identifiable by their sort,  $v$ .

The type for a ditransitive verb like *geben* 'to give' will accordingly be:

$$(52) \quad \text{geben: } (NP \setminus_{(p)} (NP \setminus_{(p,w)} (NP \setminus_{(p)} s)))_v \\ \text{where: } NP \setminus_{(p,w)} A = np_p \setminus_p A \cup np_{ph} \setminus_w A$$

This allows the following eight types:

$$(53) \quad \begin{array}{ll} (np_{ph} \setminus (np_{ph} \setminus_w (np_{ph} \setminus s)))_v & (np_{ph} \setminus (np_p \setminus_p (np_p \setminus s)))_v \\ (np_{ph} \setminus (np_{ph} \setminus_w (np_p \setminus s)))_v & (np_p \setminus_p (np_{ph} \setminus_w (np_p \setminus s)))_v \\ (np_{ph} \setminus (np_p \setminus_p (np_{ph} \setminus s)))_v & (np_p \setminus_p (np_p \setminus_p (np_{ph} \setminus s)))_v \\ (np_p \setminus_p (np_{ph} \setminus_w (np_{ph} \setminus s)))_v & (np_p \setminus_p (np_p \setminus_p (np_p \setminus s)))_v \end{array}$$

A new Inclusion Axiom is needed to allow right-headed concatenation to be reanalyzed as wrap when the right subtype is a verb:

$$(54) \quad \text{A2: } (A \circ_r B_v) \rightarrow (A \circ_w B_v)$$

This makes a configuration available for the Interaction Axiom A6, which permutes the accusative argument up a right-headed string:

$$(55) \quad \text{A6: } A \circ_R (B \circ_w C) \rightarrow B \circ_w (A \circ_R C)$$

Here ' $R$ ' is used as an abbreviation for any right-headed mode of combination, (namely,  $r$ ,  $(r)p$ , and  $(r)w$ ).

The derivation of (35) shows how these axioms apply:

$$(35') \quad \begin{array}{l} (\text{daß}_h \circ_I \text{er})_h \circ_I (\text{dem Mann} \circ_r (\text{das Buch} \circ_r \text{gibt}_v)) \\ \downarrow \text{A2} \\ (\text{daß}_h \circ_I \text{er})_h \circ_I (\text{dem Mann} \circ_r (\text{das Buch} \circ_w \text{gibt}_v)) \\ \downarrow \text{A6} \\ (\text{daß}_h \circ_I \text{er})_h \circ_I (\text{das Buch} \circ_w (\text{dem Mann} \circ_r \text{gibt}_v)) \\ \downarrow \text{A1} \\ (\text{daß}_h \circ_p \text{er}) \circ_I (\text{das Buch} \circ_w (\text{dem Mann} \circ_r \text{gibt}_v)) \\ \downarrow \text{A4} \\ \text{daß}_h \circ_I (\text{er} \circ_p (\text{das Buch} \circ_w (\text{dem Mann} \circ_r \text{gibt}_v))) \\ (s/I)_h \quad np_p \quad np_{ph} \quad np_{ph} \quad (np_{ph} \setminus (np_{ph} \setminus_w (np_p \setminus s)))_v \end{array}$$

Given the formulation of A2, the wrap mode could be introduced next to transitive or intransitive verbs as well. Applying A2 in these situations, however, would not lead to a complete derivation, as it is only a ditransitive verb that subcategorizes for its accusative argument in this mode.

It is crucial that A6 allow permutation over any right-headed mode, to account for cases where the dative argument is a pronoun. The derivation of (38) shows an application of A6 where  $R$  is instantiated as the  $p$  mode:

(38')

$$\begin{aligned}
 & ((\text{da}\beta_h \circ_l \text{er})_h \circ_l \text{ihm})_h \circ_l (\text{das Buch} \circ_r \text{gibt}_v) \\
 & \downarrow A2 \\
 & ((\text{da}\beta_h \circ_l \text{er})_h \circ_l \text{ihm})_h \circ_l (\text{das Buch} \circ_w \text{gibt}_v) \\
 & \downarrow A1 \\
 & ((\text{da}\beta_h \circ_l \text{er})_h \circ_p \text{ihm}) \circ_l (\text{das Buch} \circ_w \text{gibt}_v) \\
 & \downarrow A1 \\
 & ((\text{da}\beta_h \circ_p \text{er}) \circ_p \text{ihm}) \circ_l (\text{das Buch} \circ_w \text{gibt}_v) \\
 & \downarrow A4 \\
 & (\text{da}\beta_h \circ_p \text{er}) \circ_l (\text{ihm} \circ_p (\text{das Buch} \circ_w \text{gibt}_v)) \\
 & \downarrow A4 \\
 & \text{da}\beta_h \circ_l (\text{er} \circ_p (\text{ihm} \circ_p (\text{das Buch} \circ_w \text{gibt}_v))) \\
 & \downarrow A6 \\
 & \underline{\text{da}\beta_h} \circ_l (\text{er} \circ_p (\underline{\text{das Buch}} \circ_w (\underline{\text{ihm}} \circ_p \text{gibt}_v))) \\
 & (s/s)_h \quad \text{np}_p \quad \text{np}_{ph} \quad \text{np}_p \quad (\text{np}_p \backslash_p (\text{np}_{ph} \backslash_w (\text{np}_p \backslash_p s)))_v.
 \end{aligned}$$

Again, notice that A6 prevents the accusative NP from starting out in a higher clause by not allowing permutation over a left-headed mode. Thus a wrapping account of the word order differences between NPs and pronouns makes the correct predictions without interfering with the clustering of the pronouns.

### 3.4 Adverbials

To account for the potentially free ordering of adverbials among arguments, we can again use the wrap mode. Adverbs will be of sort **adv**, with a type that allows them to combine with an expression in the wrap mode. So the sentential adverb *trotzdem* ('nonetheless') will be assigned the category  $(s/ws)_{adv}$ .

A new Inclusion Axiom A3 allows right-headed concatenation to be reanalyzed as wrap whenever the left subtype is an adverb:

(56)

$$A3: (A_{adv} \circ_r B) \rightarrow (A_{adv} \circ_w B)$$

This will allow the resulting configuration to be available to the previously discussed Interaction Axiom, A6. This time it is the adverb which A6 permutes up a right-headed string until it gets to the top of the clause where it can take the embedded sentence as its argument. Again, the adverb cannot move over a left-headed mode, so it is predicted to always be linearized in the clause it modifies.

The derivation of (57a) provides an illustration:

- (57) a. daß der Mann den Doktor trotzdem sieht  
           *that the man the doctor nonetheless sees*

- (57a)  
       daß<sub>h</sub> °<sub>l</sub> (der Mann °<sub>r</sub> (den Doktor °<sub>r</sub> (trotzdem<sub>adv</sub> °<sub>r</sub> sieht)))  
       ↓ A3  
       daß<sub>h</sub> °<sub>l</sub> (der Mann °<sub>r</sub> (den Doktor °<sub>r</sub> (trotzdem<sub>adv</sub> °<sub>w</sub> sieht)))  
       ↓ A6  
       daß<sub>h</sub> °<sub>l</sub> (der Mann °<sub>r</sub> (trotzdem<sub>adv</sub> °<sub>w</sub> (den Doktor °<sub>r</sub> sieht)))  
       ↓ A6  
       daß<sub>h</sub> °<sub>l</sub> (trotzdem<sub>adv</sub> °<sub>w</sub> (der Mann °<sub>r</sub> (den Doktor °<sub>r</sub> sieht)))  
       (s/s)<sub>h</sub> (s/s)<sub>adv</sub>           np<sub>ph</sub>           np<sub>ph</sub>           np<sub>ph</sub>√(np<sub>ph</sub>√s)

The derivations of (57b) and (57c) will look very similar:

- (57) b. daß der Mann trotzdem den Doktor sieht  
       c. daß trotzdem der Mann den Doktor sieht

Since A3 can introduce the wrap mode next to an adverb regardless of the sort of the right hand subtype, an adverb may be linearized anywhere among the arguments in the clause it modifies.

It will be impossible, however, to derive a linearized string in which the adverb is in the middle of a pronoun cluster:

- (58) \* (daß<sub>h</sub> °<sub>l</sub> trotzdem)<sub>h</sub> °<sub>l</sub> er )<sub>h</sub> °<sub>l</sub> ihn)<sub>h</sub> °<sub>l</sub> sieht

A1 could apply to 'undo' the cluster containing *trotzdem*, but then *trotzdem* would be combined in the *p* mode, which does not match with its lexical category. And as previously discussed, pronouns must be linearized in a pronoun cluster.

The derivation of (59) provides an example of how various axioms are able to work together:

- (59) daß er dem Mann das Buch trotzdem gibt

- (59')  $(\text{da\ss}_h \circ_l \text{er})_h \circ_l (\text{dem Mann} \circ_r (\text{das Buch} \circ_r (\text{trotzdem}_{adv} \circ_r \text{gibt}_v)))$   
 $\downarrow A1$   
 $(\text{da\ss}_h \circ_p \text{er}) \circ_l (\text{dem Mann} \circ_r (\text{das Buch} \circ_r (\text{trotzdem}_{adv} \circ_r \text{gibt}_v)))$   
 $\downarrow A4$   
 $\text{da\ss}_h \circ_l (\text{er} \circ_p (\text{dem Mann} \circ_r (\text{das Buch} \circ_r (\text{trotzdem}_{adv} \circ_r \text{gibt}_v))))$   
 $\downarrow A3$   
 $\text{da\ss}_h \circ_l (\text{er} \circ_p (\text{dem Mann} \circ_r (\text{das Buch} \circ_r (\text{trotzdem}_{adv} \circ_w \text{gibt}_v))))$   
 $\downarrow A7$   
 $\text{da\ss}_h \circ_l (\text{er} \circ_p (\text{dem Mann} \circ_r (\text{trotzdem}_{adv} \circ_w (\text{das Buch} \circ_r \text{gibt}_v))))$   
 $\downarrow A7$   
 $\text{da\ss}_h \circ_l (\text{er} \circ_p (\text{trotzdem}_{adv} \circ_w (\text{dem Mann} \circ_r (\text{das Buch} \circ_r \text{gibt}_v))))$   
 $\downarrow A7$   
 $\text{da\ss}_h \circ_l (\text{trotzdem}_{adv} \circ_w (\text{er} \circ_p (\text{dem Mann} \circ_r (\text{das Buch} \circ_r \text{gibt}_v))))$   
 $\downarrow A2$   
 $\text{da\ss}_h \circ_l (\text{trotzdem}_{adv} \circ_w (\text{er} \circ_p (\text{dem Mann} \circ_r (\text{das Buch} \circ_w \text{gibt}_v))))$   
 $\downarrow A6$   
 $\text{da\ss}_h \circ_l (\text{trotzdem}_{adv} \circ_w (\text{er} \circ_p (\text{das Buch} \circ_w (\text{dem Mann} \circ_r \text{gibt}_v))))$   
 $(s/s)_h \quad (s/w)_adv \quad np_p \quad np_{ph} \quad np_{ph} \quad (np_{ph} \setminus (np_{ph} \setminus w (np_p \setminus p^s)))_v$

Thus a multimodal framework enables us to account for at least three distinct phenomena of German word order; the placement of pronouns, the difference in unmarked orders of NP and pronominal objects, and the relatively free ordering of adverbials. By assigning these expressions types of different sorts, and then allowing these sorts to have access to different modes of composition, it is possible to a large extent to predict the relevant facts.

#### 4. Remaining questions

##### 4.1 Double host problem

Given that both complementizers and NP subjects are sort **h**, the derivation of (60) shows how it is possible to derive an ungrammatical sentence in which there are two pronouns which each take a different element as its host.

- (60) \*daß es der Mann ihm gibt

(60')

$(\text{da}\beta_h \circ_l \text{es})_h \circ_l ((\text{der Mann}_h \circ_l \text{ihm})_h \circ_r \text{gibt})$   
 $\downarrow A1$   
 $(\text{da}\beta_h \circ_p \text{es}) \circ_l ((\text{der Mann}_h \circ_p \text{ihm}) \circ_r \text{gibt})$   
 $\downarrow A4$   
 $(\text{da}\beta_h \circ_p \text{es}) \circ_l (\text{der Mann}_h \circ_r (\text{ihm} \circ_p \text{gibt}))$   
 $\downarrow A4$   
 $\text{da}\beta_h \circ_l (\text{es} \circ_p (\text{der Mann}_h \circ_r (\text{ihm} \circ_p \text{gibt})))$   
 $\downarrow A4$   
 $\text{da}\beta_h \circ_l (\text{der Mann}_h \circ_r (\text{es} \circ_p (\text{ihm} \circ_p \text{gibt})))$   
 $(s/s)_h \quad \text{np}_h \quad \text{np} \quad \text{np} \quad (\text{np}_p)_p (\text{np}_h)_h (\text{np}_p)_p$

To prevent this there must be some way of restricting the number of hosts in a single clause. However, given that no lexical item subcategorizes for both hosts, it is very difficult to see how this would be accomplished in a categorial framework.

## 4.2 NP as a subphrasal sort

In §3.2 it was proposed that all nominative NPs are of sort *h*, so that they may act as hosts for pronoun clusters. However, this raises questions about why an expression which is clearly a phrase should be assigned to a subphrasal sort. The sort hierarchy is intended to distinguish composition at different prosodic levels, so that for example, once composition has occurred at the phrasal level, it is no longer possible to return to the lexical level for affixation. Since NPs must be composed at the phrasal level, it is not clear how they would then be reanalyzed as the subphrasal sort *h*.

However, considering the observation that these pronouns seem to behave like clitics, it could be that, similar to the behavior of the English possessive, the pronouns are not using the whole NP as their host, but rather some final element (David Dowty, p.c.). Thus it is not the NP itself which is sort *h*. There would have to be some way then of identifying the final element of a nominative NP as being sort *h*, but since this is not an isolated morphological phenomenon, and because this system has such expressive power, it could conceivably be worked into the present analysis.

## 5. Conclusion

This paper has motivated a possible analysis of German pronoun fronting involving clusters of pronouns around a complementizer or NP subject host. As discussed in §2.5, these hosts are peculiar to verb final clauses. An extension of the analysis to other clause types should result in finite verbs also acting as hosts for pronoun clusters in a parallel manner.

Along with word order phenomena involving sentential adverbs and the apparently idiosyncratic ordering of full NPs, it has been shown that pronoun clusters may to a large extent be accounted for in the system of multimodal logic developed in Moortgat and Oehrle (1994). While certain problems and questions remain, the overall approach appears promising.

## 6. References

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